ZYMOTIC DISEASES IN CHICAGO.

SANITARY EXHIBIT

OF THE

ILLINOIS STATE BOARD OF HEALTH.

WORLD'S COLUMBIAN EXPOSITION.

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ZYMOTIC DISEASES IN CHICAGO.

The maps, charts and diagrams which form the Sanitary Exhibit of the ILLINOIS STATE BOARD OF HEALTH at the World's Columbian Exposition are intended to illustrate the prevalence and some of the causes of zymotic or preventable diseases in Chicago during the years 1890, 1891, 1892. They are the results of an investigation begun by the Secretary during the winter of 1891-92, into the epidemic prevalence of typhoid or enteric fever. This epidemic prevalence had attracted the attention of sanitarians and health authorities elsewhere, and had finally formed the subject of a paper read before the American Statistical Association and entitled "Statistics of Typhoid Fever in Chicago," by Professors William T. Sedgwick and Allen Hazen; of the Massachusetts Institute of Technology. The substance of the paper had been widely published and commented on, not only in Chicago but throughout the United States and in Great Britain and Europe.

The opening sentences of Messrs. Sedgwick and Hazen are as follows:

"It does not appear to have been generally recognized that within the last two years, [1890-91] and especially within the last nine months, typhoid fever has been unusually prevalent in the city of Chicago. The fact, however, is that an epidemic of really alarming proportions has prevailed in Chicago within the last year, and the latest returns indicate that the city is still suffering very severely from this formidable disease. Inasmuch as a World's Fair is soon to be opened in Chicago, this unfortunate condition becomes of more than local consequence, and should excite grave apprehension. If any remedy exists it ought to be found and applied without delay. It is especially important that the sanitary condition of Chicago in 1893 should be above reproach, because that of Philadelphia in 1876

was not. At the time of the Centennial Exhibition there was much complaint of the sanitary condition of Philadelphia. Physicians can testify that numerous cases of typhoid fever which came under their observation in 1876 appeared to be plainly traceable to infection received in Philadelphia."

The gist of the paper consists of sundry tables and extracts from the official reports of the health departments of Chicago, Philadelphia, Boston, New York and London, between 1870 and 1891, showing the relative prevalence of typhoid fever in those cities as indicated by the official returns of deaths from that disease. Based upon these official data the following conclusion is arrived at by the writers:

"In the city of Chicago there has been for many years a large amount of typhoid fever. It was abundant, for example, in 1872, in 1881, in 1885 and in 1886. Between 1886 and 1890, however, it was less common; but in 1890, the death-rate from typhoid fever suddenly arose to a height almost exactly the same as that reached by Philadelphia in 1876, namely, to 9.16 deaths per 10,000 of inhabitants and 4.16 per cent. of all deaths which occurred in that year. In other words, typhoid fever prevailed as extensively in Chicago in 1890 as in Philadelphia in 1876. The actual number of deaths in Chicago in 1890 from typhoid fever was 1,008. Remarkable as these figures were they proved to be only the prelude to others still more remarkable in 1891. During the year just ended Chicago has reported 1,997 deaths from typhoid fever, giving the prodigious death-rate for this disease of 16.64 per 10,000 of population and a percentage of all deaths of 7.19. In the month of May alone there were in Chicago 408 deaths from typhoid fever, or very nearly one-half as many as in the whole state of Massachusetts during the entire twelve months of 1890, and very nearly two-thirds as many as in London, with more than 4,000,000 people, during the whole of the previous year. In the single month of May, 1891, there were more deaths from this disease in the city of Chicago than in the city of New York during the whole twelve months of 1888, or 1889, or 1890, or 1891. In 1891 there were 385 more deaths from typhoid fever in Chicago than are reported by the State Board of Health for the previous year in the whole State of New York, with five times the population; and nearly 1,400 more deaths than in London, with three and a half times the population of Chicago."

The writers add:

"It does not seem probable that these extraordinary figures can be surpassed or even maintained in 1892 or 1893, but as an indication of the sanitary condition of Chicago they must be a source of anxiety to its citizens, as they certainly are a menance to the sanitary success of the World's Fair."

Published by the Secretary, February 10, 1892.

At a conference* called by the Secretary, February 10, 1892, the foregoing facts were presented, and in commenting upon Sedgwick and Hazen's diagram—which is here reproduced—Dr. Reilly briefly traced the connection between the variations of typhoid-fever incidence and the drainage of the Chicago river into the Illinois and Michigan canal.

The first marked ascent of the Chicago black line, as shown on the diagram, is in 1872, the year following the great fire, with its consequent overcrowding from the destruction of homes and the access of thousands engaged in rebuilding. Typhoid fever was brought into the city by these thousands and found favorable conditions for its spread. These conditions, however, were only temporary, and the effect of the deepening of the Illinois and Michigan canal—completed in 1871, and by which the sewage contents of the river for a time flowed by gravity down the Illinois valley—was manifested in a general reduction of the death-rate and markedly of that from typhoid fever, as shown by the descending line, which reached its lowest point in 1880. From this lowest point the line again abruptly rises in 1881, and this ascent is due to the character of the precipitation in the winter of 1880-81, when it was unusually light, and during the year 1881, when it was unusually heavy. In November and December, 1880, and in January, 1881, there was only about one-third the usual precipitation, but February, 1881, was very wet, there being more than double the average amount of snow and rain, and a sudden thaw flushed the sewage out into the lake. The flushings of the river into the lake were repeated in June, September, October and November of this year. Up to this time the flow from the Chicago river into the canal

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*At this conference, which was held on Tuesday, February 16th, 1892, in the Mayor's office, City Hall, Chicago, there were present—

Municipal Authorities: Hempstead Washburne, Mayor; Dr. John D. Ware, Commissioner of Health; J. Frank Aldrich, Commissioner of Public Works; H. N. May, City Comptroller; J. C. Clarke, City Engineer; Prof. Walter S. Haines, City Chemist.

Sanitary District Officials: J. J. Altpeter, L. E. Cooley, B. A. Eckhardt, A. P. Gilmore and Frank Wenter, Trustees, and A. A. Goodrich, Attorney of the District.

Illinois and Michigan Canal: John C. Ames, Louis Hutt and C. E. Snively, Commissioners, and Superintendent Layton.

Newspaper Representatives: William Penn Nixon, Inter Ocean; Carter H. Harrison, Times; C. A. Dennis, Daily News; Washington Hesing, Staats Zeitung; Elias Colbert, Tribune; J. R. Dunlop, Mail; H. Wilkinson, Globe; R. Michaelis, Freie Presse.

Dr. John H. Rauch, Sanitary Counsel, and Dr. F. W. Reilly, Secretary, represented the STATE BOARD OF HEALTH.

had been entirely by gravity and the cutting of the Ogden-Wentworth ditch had turned into the canal the waters of the Des Plaines, impeded only for a short time by a dam, which soon became useless. The heavy rains absorbed the entire capacity of the canal and the Chicago river flowed out into the lake during most of the year. The rise, culminating in 1885, was due to similar causes—a two-thirds rainfall in July was followed by nearly four times the usual quantity in August. Almost six inches fell August 2, and the contents of the South Fork and of both branches of the river were whirled out into the lake, while the canal was carrying off the surface drainage.

Since 1888 there has been a constantly diminishing removal of the sewage by way of the canal and this, added to the phenomenally low lake level of 1890-91, which has tended to drain the river into the lake, has produced frequent pollution of the water supply. It hardly needs the test tube or the microscope to demonstrate this pollution, the evidence of the senses is sufficient.

In concluding his remarks, Dr. Reilly said:

"Such remedy as is feasible pending the completion of the work of the Sanitary District has been repeatedly pointed out by City Engineer Chesbrough, by committees of the Citizens' Association, by the Health Department of the city and by my predecessor in the Secretary's office of the STATE BOARD OF HEALTH, Dr. John H. Rauch. In his latest official communication on the subject, addressed to the mayor and city council of Chicago, November 27, 1889, Dr. Rauch said:

"'Owing to the increased quantity of sewage that empties into the Chicago river, and the small amount removed by the Bridgeport pumps, the river during the last season was as offensive as at any time before the deep cut in the canal was made and, in fact, as at any time in the history of the city. Not only is the river a nuisance in its present condition, but it is a positive source of danger to the health of the citizens of Chicago, which will increase with its growth in population. The sanitary interests of Chicago and the communities in the Des Plaines and Illinois valleys imperatively demand that the sewage of Chicago, pumped into the canal, shall be diluted on the minimum scale of 14,000 cubic feet per minute for every 100,000 people who drain into the Chicago river. In winter, when oxidation is retarded by ice formations, shutting out light and air, by low temperature and by impeded motion, a greater rather than a less quantity should be pumped. This is not surmise. It is absolute certainty, fully proved by careful investigations and recent analyses. As a matter of fact, the average quantity pumped during the period covered by the analyses referred to did not exceed 45,000 cubic feet

a minute during the summer of 1888, nor was it more than 38,000 cubic feet a minute during the winter of 1888-89. The larger quantity is less than one-half the minimum dilution now necessary to prevent nuisance in the river and at Joliet. The sanitary interests of Chicago require the increase of pumping to at least 120,000 cubic feet a minute at this time. With comparatively small outlay the canal can be made to carry 100,000 cubic feet a minute, though probably one or two bridges would have to be raised.

"With the sewage of more than 800,000 people already discharging into the Chicago river, the minimum dilution above specified, 14,000 cubic feet a minute to the 100,000 of people, requires at the present time that at least 120,000 cubic feet a minute be pumped. The heavy rainfall of July 27th and 28th, 1889, of over four inches, carried the accumulated sewage beyond the crib and polluted the water supply. Had it not been for the notice given to boil the water before using, and the remarkably low and equable temperature for more than a month after this heavy rainfall, the influence of this pollution of the water would have been much more marked upon health and life than it was. Under certain circumstances two inches of rainfall in twenty-four hours in this city is a menace to its water supply. Spring freshets or a rainfall in one day of three inches with the present pumping capacity always pollute the water. As compared with the benefits to be derived from this work of dilution and removal of the sewage, the cost of this temporary undertaking should cause no hesitation. It is then a matter of the most vital importance and an absolute sanitary necessity that provision be made for pumping the amount of water mentioned, and this provision should be made without delay. The conditions that obtain are a constant menace to the health of the people. Delay in this matter by those in authority, so far as the people of Chicago are concerned, is simply criminal and, as regards the adjoining communities that are imposed upon by this nuisance, it is an outrage."

Dr. Reilly added that this communication—almost prophetic in view of the developments since it was written in November, 1889—was endorsed by the STATE BOARD OF HEALTH and its transmission to the mayor and city council was authorized by the BOARD. "It expresses the views of the BOARD at the present time as to what should be done, and, while recognizing the unusual demands upon the present city administration, the BOARD urges that the remedy of the insanitary conditions which threaten the lives of the citizens and the success of the World's Fair is an imperative necessity."

Nothing of practical value resulted from this conference, and the further investigation of typhoid-fever prevalence was resumed in an attempt to distribute on a map of the city the deaths from this disease during the previous year, with the object of

securing a graphic presentation of the relations between locality, population, water supply, sewerage, etc., and the greater or lesser prevalence of the disease. Through the influence of the Hon. L. E. Cooley, one of the trustees of the Sanitary District, this work was undertaken by the Engineering Department of the District, under the personal supervision of Mr. Thos. T. Johnston, First Principal Assistant Engineer. To the intelligent interest of Messrs. Cooley and Johnston, the single map, originally projected by the Secretary, has been developed into a suite of eleven (11) maps and twenty (20) diagrams, forming an exhaustive sanitary exhibit of Chicago with reference to the prevalence and causation not only of typhoid fever, but of the zymotic or preventable diseases generally.

Except the map or chart of the Chicago watershed, these maps are of uniform size, measuring 44 by 76 inches, on a scale of three inches to the mile, and show the boundaries of the wards and of each city block. In addition to the usual ward boundaries, the area of the city is divided on these maps into sixteen assumed sections or districts, indicated by red boundary lines and numbers. These districts are based, in a general way, upon conditions of population, occupancy, etc., and may be thus described:

District No. 1. Mainly a thickly settled residence district of the wealthier classes; generally high ground, well drained and long settled. Boundaries: North, Fullerton; south, Chestnut, Division, Centre, the river; east, the lake; west, State, Wells, Sedgwick, Larrabee.

Dist. No. 2. Mainly working people of mixed classes; thickly settled; long occupied; well drained; ground medium height. Boundaries: North, Fullerton, Centre, Division, Chestnut; south, the river; east, State, Wells, Sedgwick, Larrabee; west, the river.

Dist. No. 3. Mainly working people of factory class; thinly settled, new population, high ground, partly drained. Boundaries: North, Graceland; south, Fullerton, the river; east, Clark; west, Western, the river.

Dist. No. 4. Mainly a thinly settled residence district, of the wealthier classes and of semi-suburban character. Newly settled; ground rolling—high and low—drainage partly developed, but good. Boundaries: North, Church road; south, Graceland, Clark, Fullerton; east, the lake; west, Clark, Western.

Dist. No. 5. Nainly working people of mixed classes; thickly settled; long populated but of rapid growth in last decade; high, ground, well drained generally. Boundaries: North, Belmont, the river; south, Lake, Kinzie, Division; east, the river; west, May, Robey, Kedzie.

Dist. No. 6. A mixed population, largely male. Boarding houses, slums, wholesale houses. Ground medium height, long settled, drainage complete. Boundaries: North, Lake; south, Van Buren; east the river; west, Centre, Ann.

Dist. No. 7. Mainly residence district, of middle or wealthier classes. Neither thickly nor thinly settled. Ground high; newly settled in the main; drainage partly complete. Boundaries: North, Division, Kinzie; south, C., B. & Q. R. R., Taylor; east, Robey, May, Ann, Centre, Ashland; west, Fortieth.

Dist. No. 8. Mainly working people, in large part connected with lumber industry. Thickly settled; ground low or filled up in recent years; drainage mainly complete. Rapid growth in recent years. Boundaries: North, C., B. & Q. R. R., Taylor, Van Buren; south, I. & M. canal, the river; east, I. & M. canal, the river; west, Centre, Ashland, C., B. & Q. R. R., Fortieth.

Dist. No. 9. Business district; hotels, large buildings; long settled, but of some growth in recent years; ground level and drainage complete. Boundaries: North, the river; south, Twelfth; east, the lake; west, the river.

Dist. No. 10. Mainly boarding houses of the better class, railroad yards; ground medium height, well drained. Boundaries: North, twelfth; south, Sixteenth, Twenty-sixth; east, the lake; west, Clark, the river.

Dist. No. 11. Somewhat mixed, thickly settled residence district, but mainly of the wealthier classes; high ground, well drained; north end long settled, south end recently. Boundaries: North, Twenty-sixth, the lake; south, Fifty-fifth, Thirty-ninth; east, the lake; west, Clark, State.

Dist. No. 12. Mainly working people of mixed classes; thickly settled; ground medium height; long settled and well drained. Boundaries: North, Sixteenth, the river, I. & M. canal; south, Thirty-third; east, Clark; west, the river.

Dist. No. 13. Working people, mainly occupied about stock yards and packing houses, also about railroad yards. The Union Stock Yards and the large meat packing houses are central in this district; ground tends to be low, partially drained; settled comparatively recently and of rapid growth. Boundaries: North, Thirty-ninth, Thirty-third; south, Fifty-fifth; south, Eighty-seventh; east, Stony Island avenue; west, Western avenue.

Dist. No. 14. Scattered and mixed population, probably half of the wealthier classes; ground generally low and drainage imperfect. Boundaries: North, 55th; south, 87th; east, Stony Island Avenue; west, Western Avenue.

Dist. No. 15. Mainly working people employed in the iron and other industries at South Chicago; ground low; newly settled; partly drained. Boundaries: North, 67th, the lake; south, C. & W. I. Ry., 114th; east, the lake, State line; west, Stony Island Avenue, C. & W. I. Ry.

Dist. No. 16. Pullman district, mainly of the better class of working people, largely interested in Pullman car works; ground high; well drained in a notable degree; rapid growth, comparatively recent settlement. Boundaries: North, 95th; south, Lake Calumet, 119th; east, Stony Island Avenue, Lake Calumet; west, State Street.

Districts Nos. 8, 12 and 13, embracing the region about the Stock Yards, the South Fork and Bridgeport, are subdivided by yellow lines and numbers into nine sub-districts, as follows:

District No. 8 into Sub-Districts Nos. 17 and 25.

District No. 12 into Sub-District No. 18 and parts of Nos. 19 and 20.

District No. 13 into Sub-Districts Nos. 21, 22, 23 and 24, and parts of Nos. 19 and 20.

These Sub-Districts have been made for the further study of variations in zymotic death-rates as affected by the special insanitary conditions of the regions above specified.

In the margin of each of the six mortality maps, are explanatory notes and tables of the typhoid and other zymotic death-rates per 1,000 in each District and Sub-District.

Mortality Map No. 1, shows the locality of each death from typhoid fever, during the year 1890, by a red dot on the city block where it occurred. The data were obtained from the records of the City Health Department, the County Hospital and other institutions—the street and number at which each fatal case occurred or from which a fatal case was removed to the County Hospital or other institution being noted.

Maps Nos. 2 and 3 set forth similar information as to typhoid fever mortality during the years 1891 and 1892 respectively.

Other zymotic or preventable diseases have been grouped into three classes— 1. Miasmatic, embracing diphtheria, cerebro-spinal fever, scarlet fever, measles. 2. Diarrhœal, embracing diarrhœa, dysentery, cholera morbus, cholera infantum. 3. Malarial, embracing intermittent, remittent, pernicious and other fevers of malaria. The number and locality of deaths from each of these groups of diseases and for each of the years, 1890, 1891 and 1892, are indicated on Mortality Maps Nos. 4, 5 and 6, in a manner similar to that of the typhoid-fever maps—a red dot indicating a death from one of the miasmatic group, a green dot, a death from one of the diarrhœal group, and a blue dot, a death from one of the malarial group.

Map No. 7 is a triplicate population map, showing the population and its distribution in 1880, its growth and distribution in 1886 and in 1892 respectively. For obvious reasons this is one of the most useful and important maps of the series and a corresponding amount of painstaking labor has been bestowed thereon.

In order to determine death rates, the population of the community, or parts of the community in which any set of deaths has occurred, must be known. In the case of Chicago it happens, fortunately, that census returns in minute detail are available, and, therefore, it has been practicable to make somewhat novel death-rate determinations in various parts of the city and according to different classes of population—these latter the bases of the "Assumed Districts."

The census returns, National and school, for the three periods selected, have been the basis of compilation. A map on a large scale was taken for each period and the boundaries of, and number of people in, each enumeration district were marked thereon. The population in each district was then represented on Map No. 7 by a dot, as shown. Each dot represents 500 people. It is, of course, possible that an error of 250 may be shown in any particular enumeration district, the error being thrown into an adjoining district. Any area, however, that it may be useful to consider in the investigation contains a number of enumeration districts, so that the error becomes quite small. Moreover, it cannot exceed 250 in any area that it would be profitable to investigate.

On this map the black dots show the population of Chicago and its distribution in 1880. The green dots show the increase and the distribution of the increase between 1880 and 1886, and the black and green dots together show the aggregate population in 1886. Similarly the red dots show the increase and its distribution between 1886 and 1892, and the aggregate of all the dots shows the aggregate population in 1892.

For the purpose of computing death-rates from the zymotic diseases in 1890 and in 1891 similar data were used, but these are not charted on No. 7.

The death rate data thus graphically presented on Maps Nos. 1-7, show conclusively that the manner in which people live or have to live is the most potent element governing mortality among them due to the diseases under consideration. It is only by comparing the death rates among similar classes that special causes for the virulence of the diseases may be determined.

Perhaps the best measure in this case of the manner in which people live is derived from the density of population. During his connection with the Chicago Drainage and Water Supply

Commission, Mr. Johnston made some study of population densities and incidentally compiled the following table showing the relation between the character of populations and the areas upon which they live.

Normal Densities of population for Chicago, according to occupation. Per acre and per square mile; also thousands of people per quarter of square mile.

Density per acre.	Thousands per quarter section.	Population per square mile.	Character of population.
¼	0.04	160	Farming, lumber yards, dock region and similar character.
1	0.16	640	Gardening.
2	0.32	1,280	Village suburb
4	0.48	1,920	
4	0.64	2,560	Village
5	0.80	3,200	
10	1.60	6,400	Suburban—thinly settled.
15	2.40	9,600	Suburban—average
20	3.20	12,800	Dense city suburban—first-class residences—central business sections.
30	4.80	19,200	Manufacturing district—agricultural works—car shops, planing mills—thinly settled residence of first-class order.
40	6.40	25,600	Densely settled fine residence quarter—second-class suburban population.
50	8.00	32,000	Residence district—middle-class people.
60	9.60	38,400	
70	11.20	44,800	Densely settled residence district.
70	12.80	51,200	Boarding house district—semi-business streets like Halsted.
90	14.40	57,600	
100	16.00	64,000	
110	17.60	70,400	
120	19.20	76,800	Laboring class city population, densely settled.
130	20.80	83,200	
140	22.40	89,600	
150	24.00	96,000	
25	4.00	16,000	Manufacturing—as at Pullman—population needs as much ground to work on as to live on.

Using this table in connection with the Population Map (No. 7) some conclusion may be drawn as to the character of people in any particular neighborhood. Studied in connection with death rate, population density will readily be seen to be a measure of mortality. People should not be allowed to live so thickly settled as in some quarters, if there be any way to prevent it. In 1884 Chicago had 153 acres in the 18th ward which had a population of 22,164—a density of 144 per acre. This area is now in the 23d ward. See District No. 2 on maps and diagrams.

Map No. 8 illustrates the water-supply system of Chicago. It has been compiled from the city records and shows the main distributing pipes, the pumping stations, the points in Lake Michigan at which water is taken and the location and dimensions of the water intakes. Diagram No. 1 is a detail of this map and shows the arrangement of the water-tunnel intakes at the North Side pumping station.

Maps Nos. 9 and 10 depict the sewer system and contours of the site of Chicago, respectively, and are essentially self-explanatory, as is also the chart of the Chicago water-shed.

The most interesting and significant feature of the Contour Map pertains to the central part of the city, where the original level of the ground is below the 15-ft. contour. By far the larger part of this area is what may be called made ground—much of it being "made" of garbage. The filling or making of it has extended over a long series of years and has progressed in a direction radial from the heart of the city. The larger area of recent filling probably lies in a direction northeast from the Bridgeport pumping station, though much of it is found in the vicinity of Milwaukee avenue.

Death-rate diagrams 2 to 18, inclusive, represent graphically the manner in which death-rates vary in different parts of the city and among different classes of the population. These diagrams have been projected from the mortality maps to which they refer and their data are embodied in the appended tables (Nos. 2, 3 and 4). Two general conclusions may be drawn from a comparative study of these diagrams and their related maps: 1. That there is a persistent excess of typhoid-fever deaths north of the main river in all three years, 1890, 1891, 1892—comparing similar classes of population north and south of the river. It is the section mainly supplied during these years with water from the North Shore inlet. 2. That there is a persistent excess of diarrhœal and miasmatic deaths in the region to which the South fork of the Chicago river and the Bridgeport pumping station are central. This is the region of densest filth.

Diagrams 19 and 20 show two typical instances of lake pollution on the dates given in each, when the disgusting contents of the river cesspool went directly into the water-supply intakes. The first (No. 19) in February, 1887, shows the boundaries of

the fluid filth off the mouth of the river on several days and shows how and where it entered at the two-mile crib. It also shows the disposition and movement of the sewage with reference to the currents existing on those days. The second (No. 20) in May, 1892, shows the disposition and movement of the black fluid under the influence of a different set of currents—the Hyde Park tunnel this time taking the radical pollution. During this latter period, May and June, 1892, there was an almost incessant flow of storm-water sewage into the lake, swashed back and forth in front of the city by varying currents, and menacing, if not actually polluting, the whole water supply of Chicago.

Although the data set forth in these maps and diagrams have been studied only in the most general way, certain fundamental tabular statements have been prepared which form the basis of the propositions and deductions with which this pamphlet closes.

The more important of the tabular statements are here given:

TABLE No. 1.—*Distribution of Population drained in and about Chicago and location of Drainage—1886, 1890, 1892.*

Population draining into—		1886.	1890.	1892.
North Branch..	Above Fullerton Avenue	20,500	56,500	72,000
	Below Fullerton Avenue	202,000	289,000	345,500
Main Branch...	North Side	62,000	79,500	86,000
	South Side	4,500	7,500	5,500
South Branch..	West Side	265,000	353,000	401,500
	South Side	67,500	76,500	84,500
River north of Bridgeport		621,500	862,000	995,000
South Fork.....	North of 39th Street	32,500	51,500	61,000
	South of 39th Street	43,000	93,500	138,500
Main River and Branches		697,000	1,007,000	1,194,500
Lake Michigan.	North of River	5,000	9,500	13,500
	River to 39th Street	67,500	90,500	103,500
	39th Streeet to 87th Street	27,000	51,000	68,500
Population in Sanitary District drained		796,500	1,158,000	1,380,000
City population outside Sanitary District, including South Chicago		.....	46,500	58,000
Total city population		704,000	1,204,500	1,438,000

TABLE No 2—*Population, Number of Deaths and Death Rates per 1,000 by Wards for 1890, 1891, 1892.*

1890.

WARD.		TYPHOID.		MIASMATIC.*		DIARRHŒAL.†		MALARIAL.‡	
No.	Population.	No.	Rate. Per 1000.	No.	Rate Per 1000.	No.	Rate Per 1000.	No.	Rate Per 1000.
1	44,897	8	0.18	12	0.27	21	0.47	1	0.02
2	39,562	7	0.23	16	0.52	17	0.56	2	0.07
3	39,511	11	0.36	28	0.92	14	0.46	2	0.07
4	31,345	12	0.38	19	0.61	19	0.61	3	0.10
5	40,642	31	0.76	62	1.53	69	1.79	3	0.07
6	45,199	27	0.60	70	1.55	131	2.90	6	0.13
7	45,669	22	0.48	44	0.96	58	1.27	2	0.04
8	36,589	21	0.58	42	1.15	67	1.83	2	0.05
9	41,441	39	0.72	49	0.96	89	2.15	1	0.02
10	42,925	26	0.61	54	1.26	96	2.24	4	0.09
11	37,182	15	0.49	19	0.51	22	0.59	3	0.08
12	52,127	17	0.33	41	0.79	40	0.77	2	0.04
13	37,501	26	0.69	28	0.75	35	0.63	4	0.11
14	40.724	56	1.38	78	1.92	61	1.50	5	0.12
15	42,342	39	0.92	55	1.39	86	2.03	4	0.09
16	58,699	70	1.19	65	1.11	123	2.10	4	0.07
17	28,333	35	1.24	18	0.64	46	1.62	9	0.32
18	35,126	12	0.34	17	0.48	32	0.91	1	0.03
18	48,590	13	0.27	54	1.11	90	1.85	0	0.00
20	27,126	27	1.00	24	0.89	33	1.22	1	0.04
21	35,335	31	0.88	38	1.08	33	0.93	3	0.08
22	36,565	36	0.99	44	1.21	25	0.69	3	0.08
23	41,519	47	1.13	70	1.69	52	1.25	7	0.17
24	35,120	19	0.54	20	0.57	21	0.60	2	0.06
25	23,788	32	1.35	35	1.47	14	0.59	7	0.29
26	28,003	37	1.32	46	1.64	56	2.00	7	0.25
27	11,368	5	0.44	9	0.79	12	1.06	1	0.09
28	9,085	5	0.55	10	1.10	15	1.65	1	0.11
29	81,139	22	0.71	40	1.29	53	1.70	2	0.06
30	49,718	26	0.52	76	1.53	105	2.12	6	0.12
31	20,237	12	0.59	23	1.14	28	1.38	2	0.10
32	29,312	6	0.20	30	1.02	27	0.92	2	0.07
33	29,239	21	0.72	32	1.10	43	1.47	2	0.07
34	29,611	21	0.71	27	0.91	49	1.65	10	0.34

[Deaths from typhoid fever in public institutions, 283.]
* Includes diphtheria, cerebro-spinal fever, scarlet fever, measles.
† Includes diarrhœa, dysentery, cholera morbus, cholera infantum
‡ Includes intermittent, remittent, pernicious malarial fevers.

Table No. 2—Continued.

1891.

Ward.		Typhoid.		Miasmatic.*		Diarrhœal.†		Malarial.‡	
No.	Population.	No.	Rate per 1000.	No.	Rate per 1000.	No.	Rate per 1000.	No.	Rate per 1000.
1	36,827	16	0.34	19	0.41	25	0.53	2	0.04
2	32,756	15	1.68	24	0.73	19	0.58	2	0.06
3	32,724	22	1.67	25	0.76	26	0.79	5	0.15
4	33,053	17	0.51	31	0.94	28	0.85	2	0.06
5	42,954	64	1.49	83	1.93	80	1.86	4	0.09
6	48,853	71	1.46	72	1.48	128	2.62	4	0.08
7	47,466	35	0.74	57	1.11	87	1.84	2	0.03
8	38,222	39	1.02	55	1.44	56	1.47	1	0.03
9	43,236	56	1.29	83	1.92	80	1.85	1	0.02
10	49,701	57	1.19	116	2.33	90	1.81	3	0.06
11	39,883	34	0.85	44	1.10	43	1.08	6	0.15
12	56,457	57	1.01	79	1.40	45	0.80	10	0.18
13	40,036	42	1.00	79	1.96	59	1.47	2	0.05
14	45,017	105	2.33	107	2.38	65	1.44	7	0.15
15	49,562	108	2.18	95	1.92	107	2.16	8	0.16
16	61,519	167	2.72	145	2.36	127	2.17	6	0.10
17	29,889	76	2.55	54	1.80	45	1.51	8	0.27
18	37,617	20	0.53	18	0.48	33	0.88	1	0.03
19	51,381	47	0.90	79	1.74	75	1.46	2	0.66
20	28,711	62	2.06	35	1.22	47	1.64	3	0.10
21	36,999	56	1.53	32	0.87	37	1.01	2	0.06
22	38,105	55	1.45	54	1.42	65	1.71	.....	.....
23	43,694	91	2.08	69	1.58	65	1.49	6	0.14
24	37,797	30	0.79	29	0.77	17	0.45	5	0.13
25	27,060	38	1.40	48	1.78	24	0.89	4	0.15
26	32,402	35	1.08	49	1.51	63	1.95	4	0.12
27	13,035	16	1.23	32	2.46	22	1.69	2	0.15
28	10,865	4	0.37	21	1.93	16	1.47	1	0.09
29	34,673	28	0.81	44	1.27	88	2.54	4	0.12
30	59,483	53	0.89	81	1.36	138	2.32	6	0.10
31	27,390	18	0.66	42	1.54	40	1.46	6	0.22
32	33,898	32	0.94	26	1.77	23	0.68	2	0.06
33	33,712	36	1.07	53	1.57	52	1.54	6	0.18
34	37,795	32	0.85	98	2.60	53	1.40	10	0.26

[Deaths from typhoid fever in public institutions, 363.]
* Includes diphtheria, cerebro-spinal fever, scarlet fever, measles.
† Includes diarrhœa, dysentery, cholera morbus, cholera infantum.
‡ Includes intermittent, remittent, pernicious malarial fevers.

Table No. 2—Concluded.

1892.

Ward.		Typhoid.		Miasmatic.*		Diarrhœal.†		Malarial.‡	
No.	Population.	No.	Rate per 1000.	No.	Rate per 1000.	No.	Rate per 1000.	No.	Rate per 1000.
1	48,757	5	0.10	10	0.20	16	0.33	1	0.02
2	34,951	17	0.49	32	0.92	24	0.69	1	0.03
3	34,938	31	0.89	35	1.02	15	0.43	1	0.03
4	34,762	20	0.57	26	0.75	15	0.43	3	0.09
5	45,267	63	1.39	85	1.88	60	1.35	2	0.04
6	52,503	57	1.09	76	1.45	123	2.34	3	0.06
7	49,264	42	0.85	39	0.79	60	1.22	0	0.00
8	39,905	33	0.83	53	1.33	61	1.53	1	0.02
9	45,032	44	0.96	52	1.13	76	1.66	1	0.02
10	56,477	57	1.01	73	1.29	64	1.13	1	0.02
11	42,585	35	0.82	36	0.85	28	0.66	5	0.12
12	60,788	50	0.82	53	0.87	43	0.71	9	0.15
13	42,572	52	1.22	67	1.57	38	0.89	1	0.02
14	49,310	47	0.95	64	1.30	48	0.97	4	0.08
15	56,783	65	1.14	81	1.43	72	1.27	1	0.02
16	64,340	66	1.03	72	1.12	113	1.76	1	0.02
17	31,446	24	0.76	39	1.24	29	0.92	2	0.06
18	40,109	19	0.47	17	0.42	32	0.80	4	0.10
19	54,172	33	0.61	55	1.02	74	1.37	2	0.04
20	30,296	40	1.32	36	1.19	23	0.76	2	0.06
21	38,663	40	1.03	44	1.14	36	0.93	1	0.03
22	39,706	33	0.83	43	1.08	28	0.71	0	0.00
23	45,870	51	1.11	66	1.44	67	1.46	2	0.04
24	40,474	16	0.40	13	0.32	23	0.57	0	0.00
25	30,333	24	0.79	36	1.19	10	0.33	1	0.03
26	36,802	36	0.98	48	1.30	41	1.11	4	0.11
27	14,702	11	0.75	12	0.82	14	0.95	1	0.07
28	12,645	7	0.55	23	1.82	26	2.06	1	0.08
29	38,207	17	0.45	45	1.18	80	2.10	2	0.05
30	69,249	44	0.64	114	1.65	136	1.97	8	0.12
31	34,543	14	0.41	44	1.27	28	0.81	2	0.06
32	38,385	21	0.55	48	1.25	19	0.50	1	0.03
33	38,194	27	0.71	74	1.94	35	0.92	8	0.21
34	45,980	38	0.83	59	1.28	39	0.85	5	0.11

[Deaths from typhoid fever in public institutions, 310.]
* Includes diphtheria, cerebro-spinal fever, scarlet fever, measles.
† Includes diarrhœa, dysentery, cholera morbus, cholera infantum.
‡ Includes intermittent, remittent, pernicious malarial fevers.

TABLE NO. 3—*Population, Deaths and Rates per 1,000 of Population, by Assumed Districts, for 1890, 1891, 1892.*

BOUNDARIES OF ASSUMED DISTRICTS.

Dist.	North.	South.	East.	West.
1	Fullerton	River	Lake	State
		Chestnut		Wells
		Division		Sedgwick
		Center		Larrabee
2	Fullerton	River	State	River
	Center		Wells	
	Division		Sedgwick	
	Chestnut		Larrabee	
3	Graceland	River	Clark	River
		Fullerton		Western
4	Church road	Graceland	Lake	Clark
		Clark		Western
		Fullerton		
5	River	Lake st	River	May
	Belmont	Kinzie		Robey
		Division		Kedzie
6	Lake st	Van Buren	River	Center
				Ann
7	Division	C., B. & Q. Ry	Robey	40th
	Kinzie	Taylor	May	
			Ann	
			Center	
			Ashland	
8	C., B. & Q. Ry	I. & M. canal	I. & M. canal	Center
	Taylor	River	River	Ashland
	Van Buren			C., B. & Q. Ry., 40th
9	River	12th	Lake	River
10	12th	16th	Lake	River
		26th		Clark

Table No. 3—Continued.

Dist.	North.	South	East.	West.
11	26th	55th	Lake	Clark
	Lake	39th		State
12	16th	33d	Clark	River
	River			I. & M. canal
	I. & M. canal			
13	39th	55th	Clark	Western
	33d		State	
14	55th	87th	Stony Island	Western
15	67th	C. & W. I. Ry.	Lake	Stony Island
	Lake	114th	State line	C. & W. I. Ry.
16	95th	Lake Calumet	Stony Island	State st
		119th	Lake Calumet	

BOUNDARIES OF SUB-DISTRICTS.

17	16th St.	River	River	Crawford
	C. B. & Q. R. R.			C., B. & Q. R. R.
18	River	33d and 26th	Wentworth	Halsted
			Clark	
19	River & 33d	39th St.	Halsted	South Fork
			Stewart Ave.	
20	River	39th St.	South Fork	Western
21	39th St.	47th St.	State	Western
22	47th St.	55th St.	State	Western
23	39th & 47th.	55th St.	Ashland	Western
			Halsted	
24	39th St.	55th St.	State	Halsted
25	Van Buren	16th St.	River	Centre
	Taylor			Ashland

Table No. 3—Continued.

Population, Deaths and Rates per 1000 during 1890.

Dist.	Population.	Typhoid.		Miasmatic.		Diarrhœal.		Malarial.	
		Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.
1	45,500	34	.75	33	.73	23	.51	3	.07
2	122,000	122	1.00	175	1.44	109	.89	8	.06
3	38,000	58	1.53	58	1.52	41	1.08	8	.21
4	11,500	7	.63	14	1.22	5	.43	2	.17
5	174,500	196	1.13	215	1.23	268	1.53	16	.009
6	18,000	11	.61	16	.88	28	1.55	1	.05
7	148,000	46	.28	137	.92	100	.68	11	.07
8	163,500	92	.57	208	1.27	294	1.80	3	.02
9	44,500	10	.22	14	.31	18	.40	.....	.....
10	30,500	7	.23	20	.65	19	.62	3	.10
11	71,500	25	.35	56	.78	37	.52	5	.07
12	66,500	37	.56	101	1.52	127	1.91	5	.07
13	91,000	49	.54	132	1.45	160	1.76	9	.099
14	55,500	27	.49	50	.90	59	1.06	6	.11
15	27,500	18	.66	29	1.06	34	1.23	3	.11
16	16,000	9	.56	7	.44	9	.56	.....	.....
17	95,000	58	.61	92	.97	160	1.68	1	.01
18	40,500	23	.56	56	1.38	54	1.33	3	.07
19	35,000	27	.77	41	1.17	90	2.58	4	.11
20	10,500	1	.09	30	2.86	19	1.81	1	.09
21	28,500	12	.42	33	1.16	45	1.58	2	.07
22	29,000	18	.62	50	1.72	77	2.36	5	.17
23	18,500	9	.48	41	2.22	58	3.14	2	.11
24	39,000	21	.54	42	1.08	33	.85	5	.13
25	90,000	35	.39	105	1.17	135	1.50	2	.02

Table No. 3—Continued.

Population, Deaths and Rates per 1000 during 1891.

Dist.	Population.	Typhoid.		Miasmatic.		Diarrhœal.		Malarial.	
		Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.
1	53,200	36	.68	57	1.07	25	.47	5	.09
2	128,000	222	1.75	178	1.39	121	.94	12	.09
3	42,500	43	1.00	83	1.95	36	.85	8	.18
4	12,200	13	1.07	20	1.64	8	.65	2	.16
5	191,200	349	1.83	425	2.22	201	1.05	21	.11
6	29,500	20	.68	19	.64	24	.81	1	.03
7	158,700	123	.78	234	1.47	129	.81	17	.11
8	188,700	176	.93	368	1.95	266	1.41	6	.03
9	46,500	15	.32	16	.33	15	.32	2	.04
10	31,200	18	.58	39	1.25	22	.71	1	.03
11	83,700	47	.57	92	.86	47	.57	7	.08
12	70,500	89	1.27	105	1.49	85	1.21	7	.10
13	100,500	81	.81	191	1.90	243	2.42	9	.09
14	65,700	51	.77	51	.78	73	1.11	9	.14
15	31,700	26	.81	51	1.61	41	1.29	8	.25
16	20,000	8	.40	29	1.45	6	.30	5	.25
17	106,000	86	.81	201	1.90	161	1.52	1	.01
18	42,700	55	1.29	91	2.13	58	1.36	2	.05
19	37,500	46	1.23	58	1.53	67	1.79	3	.08
20	12,000	16	1.33	22	1.83	13	1.08	.....	.....
21	32,500	15	.46	42	1.29	75	2.31	5	.15
22	35,700	24	.67	75	2.10	98	2.75	3	.08
23	23,500	13	.55	46	1.95	89	3.80	3	.13
24	44,200	26	.59	69	1.56	80	1.81	5	.11
25	93,500	91	.97	157	1.78	115	1.23	5	.05

Table No. 3—Continued.

Population, Deaths and Rates per 1000 during 1892.

Dist.	Population.	Typhoid.		Miasmatic.		Diarrhœa.		Malarial.	
		Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.	Deaths	Rates per 1000.
1	61,000	34	0.56	26	0.43	21	0.34	.....	.....
2	134,000	146	1.09	176	1.31	156	1.16	5	0.04
3	47,000	45	0.96	71	1.51	46	0.98	4	0.09
4	13,000	15	1.15	13	1.00	5	0.38	1	0.08
5	208,000	227	1.09	272	1.31	273	1.31	9	0.04
6	40,000	19	0.48	17	0.43	32	0.80	4	0.10
7	170,500	142	0.83	184	1.08	113	0.66	15	9.09
8	214,000	179	0.84	228	1.07	321	1.50	4	0.02
9	48,500	5	0.10	10	0.21	16	0.33	1	0.02
10	32,000	17	0.53	32	1.00	24	0.75	1	0.03
11	96,000	68	0.71	92	0.96	39	0.41	4	0.04
12	74,500	92	1.24	129	1.73	137	1.84	3	0.04
13	110,000	72	0.66	162	1.47	237	2.16	10	0.09
14	76,000	59	0.78	115	1.51	69	0.91	6	0.08
15	36,000	25	0.69	72	2.00	35	0.97	8	0.22
16	24,000	9	0.37	12	0.50	10	0.79	2	0.08
17	117,000	101	0,86	116	0.99	168	1.43	1	0.01
18	45,000	63	1.40	85	1.89	59	1.31	2	0.04
19	40,000	45	1.12	57	1.42	106	2.65	2	0.05
20	13,500	12	0.89	19	1.41	17	1.26	1	0.07
21	36,500	17	0.47	42	1.15	77	2.11	2	0.06
22	42,500	23	0,54	71	1.67	105	2.47	5	0.12
23	28,500	16	0.56	44	1.54	100	3.50	4	0.14
24	49,500	24	0.48	68	1.37	78	1.58	3	0.06
25	97,000	78	0.80	112	1.15	149	1.54	3	0.03

TABLE No. 4—*Zymotic Diseases.—Death Rates per 1000 of Population per annum—1890, 1891, 1892.*

Year.	Population.	Typhoid.	Miasmatic	Diarrhœal	Malarial.
1890	1,208,000	1.00	1.06	1.19	0.10
1891	1,322,000	1.51	1.53	1.25	0.11
1892	1,438,000	1.04	1.26	1.07	0.10

Zymotic Diseases: Deaths and Death Rates per 1000, by Months—1890.

Months.	Typhoid.		Miasmatic.		Diarrhœal.		Malarial.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths	Rate.
January	53	0.53	140	1.39	38	0.38	8	0.08
February	136	1.35	131	1.30	41	0.41	11	0.11
March	103	1.02	155	1.53	21	0.21	12	0.12
April	45	0.45	107	1.06	21	0.21	9	0.09
May	82	0.81	93	0.92	22	0.22	15	0.15
June	107	1.06	81	0.80	85	0.84	9	0.09
July	86	0.85	70	0.70	571	5.66	7	0.07
August	115	1.14	75	0.74	398	3.95	16	0.16
September	95	0.94	92	0.91	165	1.64	9	0.09
October	72	0.71	83	0.83	54	0.54	10	0.10
November	67	0.66	110	1.09	14	0.14	7	0.07
December	47	0.47	146	1.45	7	0.07	8	0.08
Totals	1,008	.....	1,283	.....	1,437	.....	121	.....
Annual death-rates.	.....	1.00	.....	1.06	.....	1.19	.....	0.10

Table No. 4—Concluded.

Zymotic Diseases: Deaths and Death Rates per 1000, by Months—1891.

Months.	Typhoid.		Miasmatic.		Diarrhœal.		Malarial.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths	Rate.
January	67	0.61	176	1.60	18	0.15	7	0.06
February	61	0.55	195	1.77	26	0.23	9	0.08
March	71	0.64	216	1.96	45	0.41	16	0.15
April	136	1.23	171	1.55	136	1.23	18	0.16
May	408	3.71	170	1.55	66	0.60	22	0.20
June	167	1.52	135	1.23	68	0.62	7	0.06
July	200	1.82	106	0.96	476	4.32	10	0.09
August	182	1.65	128	1.16	416	3.78	14	0.13
September	198	1.80	132	1.20	238	2.16	8	0.07
October	171	1.55	185	1.68	95	0.86	12	0.11
November	150	1.36	205	1.86	28	0.25	10	0.09
December	186	1.69	204	1.86	38	0.34	10	0.09
Totals	1,997	.....	2,023	.....	1,650	.....	143	.....
Annual death-rates	.....	1.51	.....	1.53	.....	1.25	.....	0.11

Zymotic Diseases: Deaths and Death Rates per 1000, by Months—1892.

Months.	Typhoid.		Miasmatic.		Diarrhœal.		Malarial.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths	Rate.
January	311	2.59	218	1.82	51	0.42	9	0.07
February	187	1.56	150	1.25	20	0.17	8	0.07
March	76	0.63	174	1.45	14	0.12	9	0.07
April	56	0.47	138	1.15	36	0.30	5	0.04
May	70	0.58	137	1.15	40	0.33	10	0.08
June	55	0.46	98	0.82	114	0.95	16	0.13
July	211	1.76	100	0.83	516	4.30	21	0.17
August	179	1.49	97	0.80	435	3.62	27	0.22
September	138	1.15	93	0.77	204	1.70	13	0.11
October	92	0.77	164	1.37	69	0.57	8	0.07
November	67	0.56	192	1.60	25	0.21	6	0.05
December	47	0.39	243	2.02	17	0.14	7	0.06
Totals	1,489	.....	1,804	.....	1,541	.....	139	.....
Annual death-rates	.....	1.04	.....	1.26	.....	1.07	.....	0.10

TABLE NO. 5.—*Precipitation Data, Chicago, 1871–1892, inclusive.*

1871—MONTH.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	STORMS.*			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	4.13	10	1.20	13	1.20	24-	.....
	.....	.....	.....	14	1.10	24-	.....
February	1.45	6	0.78	.....	.....	.....	.....
March	2.66	15	0.71	.....	.....	.....	.....
April	3.70	15	2.41	10	2.41	24-	.....
May	3.90	9	1.03	25	1.05	24-	.....
June	5.56	12	2.57	22	2.57	24-0	.....
	.....	.....	.....	23	2.13	0-60	2.13
July	2.52	9	1.57	3	1.57	24-	.....
August	2.01	8	0.73	.....	.....	.....	.....
September	0.74	3	0.53	.....	.....	.....	.....
October	1.88	Record broken by fire.	1.41	31	1.41	24-	.....
November	3.62	11	1.24	10	1.24	24-	.....
December	3.44	10	2.50	23	2.50	24-	.....
Totals	35.61	.....	.....	.....	.....	.....	.....

1872—MONTH.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	STORMS.*			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	0.68	7	0.26	.....	.....	.....	.....
February	0.84	6	0.42	.....	.....	.....	.....
March	3.29	9	1.88	7	1.15	24-	.....
	.....	.....	.....	30	1.29	24-	.....
April	3.03	11	0.71	.....	.....	.....	.....
May	3.24	9	0.96	.....	.....	.....	.....
June	3.45	10	1.21	.....	.....	.....	.....
July	3.09	11	1.14	.....	.....	.....	.....
August	2.59	11	0.89	.....	.....	.....	.....
September	6.43	12	2.70	28	2.70	24-	.....
October	0.65	4	0.43	.....	.....	.....	.....
November	1.06	11	0.77	.....	.....	.....	.....
December	0.22	10	0.04	.....	.....	.....	.....
Totals	29.07	111	.....	.....	.....	.....	.....

*These columns include all storms whose rate of fall was greater than one inch per hour, and those also the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1873—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	2.56	14	0.81	.....	.....	.....	.....
February	0.47	5	0.23	.....	.....	.....	.....
March	0.89	13	0.26	.....	.....	.....	.....
April	6.22	17	1.66	6	1.03	24-	.....
	.....	.....	.....	11	1.06	24-	.....
May	7.20	16	2.82	1	2.35	24-	.....
	.....	.....	.....	9	1.90	24-	.....
June	1.44	6	0.57	.....	.....	.....	.....
July	4.04	15	1.35	4	1.35	24-	.....
August	1.58	10	0.58	.....	.....	.....	.....
September	3.53	10	1.94	28	1.44	24-	.....
October	2.43	10	1.73	.....	.....	.....	.....
November	1.61	11	0.54	.....	.....	.....	.....
December	4.44	12	1.21	3	1.12	24-	.....
	.....	.....	.....	11	.99	24-	.....
	.....	.....	.....	12	1.11	24-	.....
Totals	36.41	139	.....	.....	.....	.....	.....

1874—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	3.47	14	1.04	.....	.....	.....	.....
February	1.51	14	0.57	.....	.....	.....	.....
March	2.15	9	1.20	3	1.19	24-	.....
April	2.67	9	1.45	.....	.....	.....	.....
May	2.08	11	0.64	.....	.....	.....	.....
June	3.25	10	1.45	8	1.45	24-	.....
July	0.58	7	0.43	.....	.....	.....	.....
August	3.15	8	2.19	21	2.00	24-	.....
September	3.76	9	1.28	4	1.02	24-	.....
October	2.55	10	1.56	28	1.53	24-	.....
November	2.83	14	0.79	.....	.....	.....	.....
December	0.63	10	0.31	.....	.....	.....	.....
Totals	28.63	1.25	.....	.....	.....	.....	.....

* These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1875—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms. Date.	Amount of fall in inches.	Duration, hours and minutes.	Rate incher per hour.
January	0.96	14	0.58	.....	.....	.....	.....
February	1.99	12	0.65	.....	.....	.....	.....
March	1.43	16	0.36	.....	.....	.....	.....
April	2.32	12	1.03	.....	.....	.....	.....
May	3.64	16	1.10	.....	.....	.....	.....
June	5.17	15	1.70	1	1.11	24-	.....
	.....	.....	.....	21	1.58	24-	.....
July	7.18	16	2.29	6	1.40	24-	.....
	.....	.....	.....	27	2.22	24-	.....
August	3.29	11	1.23	15	1.22	24-	.....
September	4.39	11	3.44	9	3.44	24-	.....
October	4.32	13	1.49	29	1.19	24-	.....
November	0.75	10	0.35	.....	.....	.....	.....
December	2.62	13	0.66	.....	.....	.....	.....
Totals	38.06	159	.....	.....	.....	.....	.....

1876—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amonnt of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	3.22	12	1.53	18	1.51	24-	.....
February	3.90	11	1.94	9	1.56	24-	.....
March	4.04	16	1.67	16	1.64	24-	.....
April	2.07	10	1.51	13	1.24	24-	.....
May	1.85	15	0.79	.....	.....	.....	.....
June	5.96	17	1.87	16	1.87	24-	.....
July	3.11	11	1.91	.....	.....	.....	.....
August	3.66	8	1.82	24	0.88	0-35	1.50
	.....	.....	.....	30	1.51	24-0	.....
September	3.74	12	1.72	13	1.72	24-	.....
October	1.20	9	0.44	.....	.....	.....	.....
November	3.25	16	0.93	.....	.....	.....	.....
December	0.48	16	0.14	.....	.....	.....	.....
Totals	36.48	153	.....	.....	.....	.....	.....

*These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1877—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.*			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.91	9	1.02	.....	.....	.....	.....
February	0.06	3	0.06	.....	.....	.....	.....
March	5.37	20	0.91	.....	.....	.....	.....
April	2.42	13	0.68	.....	.....	.....	.....
May	1.81	6	0.73	.....	.....	.....	.....
June	6.04	20	2.65	25	2.63	24-	.....
July	2.98	10	1.47	2	0.84	0-50	1.01
August	3.06	12	1.26	2	1.47	24-	.....
	.....	.....	.....	14	1.14	24-	.....
September	2.02	7	1.19	28	1.19	24-	.....
October	6.51	15	2.55	19	2.19	24-	.....
November	6.08	15	1.66	8	1.66	24-	.....
December	2.75	18	1.02	18	1.02	24-	.....
Total	41.01	148	.....	.....	.....	.....	.....

1878—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.*			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.31	18	0.72	.....	.....	.....	.....
February	2.12	16	0.76	.....	.....	.....	.....
March	4.39	16	1.50	28	1.19	24-	.....
April	5.57	14	1.55	23	1.01	24-	.....
	.....	.....	.....	24	1.53	24-	.....
May	5.22	14	1.66	28	1.16	24-	.....
June	3.02	12	0.87	.....	.....	.....	.....
July	6.09	11	4.14	26	4.14	24-	.....
August	3.66	15	1.36	18	1.36	24-	.....
	.....	.....	.....	25	1.02	24-	.....
September	1.99	10	1.16	25	0.92	0-08	6.90
October	5.17	17	1.41	16	1.41	24-	.....
November	0.83	11	0.22	.....	.....	.....	.....
December	2.58	21	0.69	.....	.....	.....	.....
Totals	41.95	175	.....	.....	.....	.....	.....

*These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1879—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.*			
				Date.	Amount of fall in inches.	Duration, hours and minutes.	Rate inches per hour.
January	0.54	9	0.41	.....	.....	.....	.....
February	1.47	17	0.36	.....	.....	.....	.....
March	2.37	15	0.87	.....	.....	.....	.....
April	1.93	10	1.48	9	1.36	24-	.....
May	3.89	10	2.52	25	2.52	24-	.....
June	3.18	12	1.02	21	1.02	24-	.....
July	5.58	9	3.25	6	1.17	24-	.....
	.....	.....	.....	7	2.23	24-	.....
August	0.45	7	0.16	.....	.....	.....	.....
September	1.18	12	0.40	.....	.....	.....	.....
October	2.72	10	1.43	17	1.22	24-	.....
November	4.93	12	1.50	28	1.50	24-	.....
December	2.47	18	1.10	9	1.10	24-	.....
Total	30.71	141	.....	.....	.....	.....	.....

1880—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Rate in hes per hour.
January	3.53	14	0.95	.....	.....	.....	.....
February	2.91	14	1.17	.....	.....	.....	.....
March	2.25	13	1.15	27	1.08	24-	.....
April	5.20	19	1.65	24	1.65	24-	.....
May	4.97	12	1.26	8	1.26	24-	.....
June	3.50	17	1.17	14	1.05	24-	.....
July	3.07	15	0.84	.....	.....	.....	.....
August	4.47	15	1.25	.....	.....	.....	.....
September	2.25	18	0.89	.....	.....	.....	.....
October	3.19	10	1.91	3	1.30	24-	.....
November	0.87	14	0.45	.....	.....	.....	.....
December	1.11	20	0.45	.....	.....	.....	.....
Totals	37.32	181	.....	.....	.....	.....	.....

* These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1881—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	0.87	16	0.24	.....	.....	.....	.....
February	5.98	20	1.34	.....	.....	.....	.....
March	2.99	12	1.04	19	1.04	24-	.....
April	1.84	15	0.86	.....	.....	.....	.....
May	1.85	10	0.68	.....	.....	.....	.....
June	5.93	18	2.57	6	1.18	24-	.....
	.....	.....	.....	7	1.43	24-	.....
July	4.31	10	1.81	21	1.69	24-	.....
August	0.54	6	0.30	.....	.....	.....	.....
September	4.34	13	1.10	15	1.08	24-	.....
October	6.89	17	1.24	14	1.15	24-	.....
	.....	.....	.....	24	1.00	24-	.....
November	5.97	15	3.35	11	3.18	24-	.....
December	2.67	15	1.14	21	1.14	24-	.....
Totals	44.18	173	.....	.....	.....	.....	.....

1882—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.55	16	0.49	.....	.....	.....	.....
February	2.24	13	1.35	28	1.35	24-	.....
March	3.43	20	1.43	9	1.43	24-	.....
April	6.72	17	1.58	9	1.49	24-	.....
	.....	.....	.....	26	1.33	24-	.....
May	5.52	19	1.77	6	1.20	24-	.....
	.....	.....	.....	27	1.60	24-	.....
June	5.71	20	1.92	3	1.17	24-	.....
	.....	.....	.....	27	0.56	0-13	2.58
	.....	.....	.....	30	1.55	24-	.....
July	3.43	14	1.00	.....	.....	.....	.....
August	4.96	18	1.69	23	1.65	24-	.....
September	0.91	8	0.63	.....	.....	.....	.....
October	3.40	12	1.17	8	1.15	24-	.....
November	1.48	17	0.45	.....	.....	.....	.....
December	1.99	16	0.81	.....	.....	.....	.....
Totals	41.34	190	.....	.....	.....	.....	.....

*These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1883—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration, hours and minutes.	Rate inches per hour.
January	1.74	19	1.60	.....	.....	.....	.....
February	4.74	17	1.94	16	1.94	24-	.....
March	0.42	15	0.18	5	1.32	24-	.....
April	3.72	14	1.38	.....	.....	.....	.....
May	7.32	18	2.37	9	2.20	24-	.....
June	5.61	14	1.20	5	0.64	0-10	3.84
	.....	.....	.....	12	1.20	24-	.....
July	5.53	12	1.77	4	1.60	24-	.....
	.....	.....	.....	21	1.20	24-	.....
August	1.21	7	1.05	.....	.....	.....	.....
September	1.36	8	0.68	.....	.....	.....	.....
October	7.36	19	1.94	3	1.33	24-	.....
	.....	.....	.....	25	1.94	24-	.....
November	5.26	10	3.39	5	3.39	24-	.....
December	1.59	15	0.52	.....	.....	.....	.....
Totals	45.86	168	.....	.....	.....	.....	.....

1884—Month.	Total Rainfall in Inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.39	14	0.39	.....	.....	.....	.....
February	3.27	20	1.13	12	1.13	24-	.....
March	5.16	19	3.26	25	3.26	24-	.....
April	3.05	14	1.74	15	1.74	24-	.....
May	1.53	12	0.68	.....	.....	.....	.....
June	2.11	11	0.64	2	.52	24-	.....
July	3.71	12	1.46	.....	.....	.....	.....
August	2.50	9	1.27	28	1.27	24-	.....
September	2.29	9	1.09	27	1.09	24-	.....
October	3.59	13	1.39	8	1.26	24-	.....
November	1.80	12	0.87	.....	.....	.....	.....
December	4.21	19	0.95	.....	.....	.....	.....
Totals	34.61	164	.....	.....	.....	.....	.....

* These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1885—Month.	Total rainfall in inches.	No. of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	3.18	12	1.24	.....	.....	.....	.....
February	2.01	16	0.99	.....	.....	.....	.....
March	0.57	11	0.20	.....	.....	.....	.....
April	4.00	18	1.71	17	1.71	24-0	.....
May	3.17	14	1.23	29	1.23	24-0	.....
June	5.20	13	3.44	3	3.44	21-0	0.90
	.....	.....	.....	2	2.90	3-15	.....
July	2.44	16	0.83	.....	.....	.....	.....
August	11.28	15	6.19	2&3	6.19	24-0	.....
	.....	.....	.....	23	1.92	24-0	.....
	.....	.....	.....	24	2.00	24-0	.....
September	2.97	13	1.65	8	1.65	24-0	.....
October	3.87	16	2.22	19	2.22	24-0	.....
November	2.33	15	1.17	.....	.....	.....	.....
December.	3.35	19	1.29	8	1.21	24-	
Totals	44.37	178	.....	.....	.....	.....	.....

1886—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	3.56	22	0.71	.....	.....	.....	.....
February	1.51	15	0.53	.....	.....	.....	.....
March	1.79	15	0.54	.....	.....	.....	.....
April	1.29	14	0.42	.....	.....	.....	.....
May	1.00	12	0.52	.....	.....	.....	.....
June	0.94	10	0.58	.....	.....	.....	.....
July	1.53	9	0.61	.....	.....	.....	.....
August	3.38	11	1.30	29	1.10	24-	.....
September	6.93	18	2.11	9	1.67	24-	.....
	.....	.....	.....	19	1.10	24-	.....
October	1.42	8	0.59	.....	.....	.....	.....
November	1.66	13	0.74	.....	.....	.....	.....
December	1.76	18	0.37	.....	.....	.....	.....
Totals	26.77	165	.....	.....	.....	.....	.....

*These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1887—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	3.13	18	1.39	22	1.39	24-	
February	5.10	19	1.23	8	1.10	24-	
				17	1.02	24-	
March	0.89	13	0.48				
April	0.46	12	0.18				
May	1.38	12	0.49				
June	1.63	11	0.70	20	.70	0-24	1.24
July	1.05	13	0.45				
August	3.35	13	1.24	14	1.23	24-	
September	4.03	15	1.33	22	1.00	24-	
October	2.03	12	0.82				
November	2.41	7	0.66				
December	3.67	21	1.04	3	1.04	24-	
Totals	29.13	166					

1888—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.56	22	0.51				
February	1.51	12	0.76				
March	2.99	18	1.01				
April	2.13	12	0.90				
May	6.22	20	2.43	27	1.14	24-	
				28	0.75	0-19	2.40
				28	1.46	24-	
June	1.66	10	0.97				
July	3.93	14	1.29	4	1.02	24-0	
				3	0.75	0-23	1.98
				31	1.29	24-0	
August	2.10	13	1.00				
September	0.98	7	0.45				
October	2.95	12	1.31				
November	2.89	11	1.10	8	1.10	24-0	
December	1.94	14	0.98				
Totals	30.86	165					

* These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Continued.

1889—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration, hours and minutes.	Rate, inches per hour.
January	1.64	13	0.68	.....	.....	.....	.....
February	1.31	15	0.44	.....	.....	.....	.....
March	1.43	9	0.93	.....	.....	.....	.....
April	2.35	13	1.03	.....	.....	.....	.....
May	5.38	19	1.42	13	1.32	24-	.....
June	2.93	14	0.68	.....	.....	.....	.....
July	9.56	12	4.02	19	1.55	0-35	2.66
	.....	.....	.....	27	4.02	3-34	1.13
	.....	.....	.....	18	0.80	0-10	4.80
	.....	.....	.....	14	1.48	24-00	.....
August	0.39	8	0.16	.....	.....	.....	.....
September	2.75	11	2.08	5	1.14	24-0	.....
October	1.82	10	0.82	.....	.....	.....	.....
November	3.49	18	1.47	1	1 02	24-0	.....
December	1.90	16	0.95	.....	.....	.....	.....
Totals	34.95	158	.....	.....	.....	.....	.....

1890—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.* Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	2.98	16	0.94	.....	.....	.....	.....
February	2.42	16	0.53	.....	.....	.....	.....
March	2.10	19	0.60	.....	.....	.....	.....
April	3.28	15	0.90	.....	.....	.....	.....
May	5.13	19	2.60	9	2.60	24-	.....
	.....	.....	.....	24	1.03	.....	.....
June	3.25	17	1.03	11	1.01	24-0	.....
July	2.57	7	1.31	4	1.04	1-00	1.04
	.....	.....	.....	14	1.00	0-34	1.76
	.....	.....	.....	14	1.31	24-0	.....
August	2.58	12	1.47	21	1.16	24-0	.....
September	1.39	10	0.98	.....	.....	.....	.....
October	4.20	19	1.16	26	1.16	24-	.....
November	1.59	12	0.84	.....	.....	.....	.....
December	1.25	12	0.47	.....	.....	.....	.....
Totals	32.69	174	.....	.....	.....	.....	.....

* These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

Table No. 5—Concluded.

1891—Month.	Total rainfall in inches.	Number of days.	Maximum daily amount in inches.	Storms.*			
				Date.	Amount of fall in inches.	Duration hours and minutes.	Date. inches per hour.
January	1.99	16	1.25	1	1.25	24-0	
February	1.95	14					
March	2.13	22	0.58				
April	3.14	18	1.45	9	1.48	24-0	
May	2.09	10	0.84				
June	2.42	14	0.79				
July	2.47	9	1.28	7	1.26	24-0	
August	4.52	14	1.92	7 23 & 4	1.10 1.92	0-43 24-0	1.53
September	0.32	6					
October	0.86	7					
November	3.83	21	0.84				
December	1.32	14	0.56				
Totals	26.54	165					

1892—Month.	Total rainfall in inches.	Number of days.		Maximum daily amount in inches.	Storms.*			
		Including "trace."	"Trace" only.		Date.	Amount of fall in inches.	Duration hours and minutes.	Rate inches per hour.
January	1.99	15		0.57				
February	1.57	20		0.42				
March	2.21	16		0.59				
April	2.17	16		0.70				
May	6.77	23		1.66	5	1.66	24-	
June	10.58	28		2.04	18 23	1.80 3.04	24- 24-	
July	2.23	12	3	0.81				
August	1.85	8		0.48				
September	1.34	11	1	0.82				
October	1.54	7	1	0.67				
November	2.68	15	3	1.43				
December	1.63	18	7	0.85				
Totals	36.56							

*These columns include all storms whose rate of fall was greater than one inch per hour, and also those the amount of whose fall was greater than one inch in the recorded day, viz.: 11 P. M. to 11 P. M.

TABULATION OF
(1871–
AT CHICAGO,

MONTH.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
January.....	4.13	0.68	2.56	3.47	0.96	3.22	1.91	1.31	0.54	3.53	0.87
February.....	1.45	0.84	0.47	1.51	1.99	3.90	0.06	2.12	1.47	2.91	5.98
March	2.66	3.79	0.89	2.15	1.43	4.04	5.37	4.39	2.37	2.25	2.99
April.....	3.70	3.03	6.22	2.67	2.32	2.07	2.42	5.57	1.93	5.20	1.84
May.....	3.90	3.24	7.20	2.09	3.64	1.85	1.81	5.22	3.89	4.97	1.85
June.....	5.56	3.45	1.44	3.25	5.17	5.96	6.04	3.02	3.18	3.50	5.93
July.....	2.52	3.09	4.04	0.58	7.18	3.11	2.98	6.09	5.58	3.07	4.31
August.....	2.01	2.59	1.58	3.15	3.29	3.66	3.06	3.66	0.45	4.47	0.54
September.....	0.74	6.43	3.53	3.76	4.39	3.74	2.02	1.99	1.18	2.25	4.34
October.....	1.88	0.65	2.43	2.55	4.32	1.20	6.51	5.17	2.72	3.19	6.89
November.....	3.62	1.06	1.61	2.83	0.75	3.25	6.08	0.83	4.93	0.87	5.97
December.....	3.44	0.22	4.44	0.63	2.62	0.48	2.75	2.58	2.47	1.11	2.67
Totals.....	35.61	29.07	36.41	28.63	38.06	36.48	41.01	41.95	30.71	37.32	44.18

NOTE.—The yearly mean of these 22 years, 1871–1892, inclusive, was 35.59 inches, which may be assumed as the normal rainfall. During the first seven years of this period—1871–1877, inclusive,—the yearly mean was 35.04 inches, being a slight deficiency and a stationary lake level; in the seven years, 1878–1884, the yearly mean was 39.43 inches, a marked excess and a rising lake level; in the following seven years, 1885–1891, the mean was 32.18 inches, and a falling lake level. If the periods begin with 1872, the result is substantially the same: 1872–1878, yearly mean, 35.94 inches; 1879–85, yearly mean, 39.77 inches; 1886–1892, yearly mean, 31.20 inches, and a lower lake level than at any previous time for fifty years. It is reasonable now to expect a series of years of increasing rainfall, with a rising lake level.

MONTHLY RAINFALLS

1892)

ILLINOIS.

1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	Means.
1.55	1.74	1.39	3.18	3.56	3.13	1.56	1.64	2.98	1.99	1.99	2.18
2.24	4.74	3.27	2.01	1.51	5.10	1.51	1.31	2.42	1.95	1.57	2.29
3.43	0.42	5.16	0.57	1.79	0.89	2.99	1.43	2.10	2.13	2.21	2.52
6.72	3.72	3.05	4.00	1.29	0.46	2.13	2.35	3.28	3.14	2.17	3.15
5.52	7.32	1.53	3.17	1.00	1.38	6.22	5.38	5.13	2.09	6.77	2.87
5.71	5.61	2.11	5.20	0.94	1.63	1.66	2.93	3.25	2.42	10.58	4.03
3.43	5.53	3.71	2.44	1.53	1.05	3.93	9.56	2.57	2.47	2.23	3.75
4.96	1.21	2.50	11.28	3.38	3.35	2.10	0.39	2.58	4.52	1.85	3.08
0.91	1.36	2.29	2.97	6.93	4.03	0.98	2.75	1.39	0.32	1.34	2.78
3.40	7.36	3.59	3.87	1.42	2.03	2.95	1.82	4.20	0.36	1.54	3.26
1.48	5.26	1.80	2.33	1.66	2.41	2.89	3.49	1.59	2.83	2.68	2.79
1.99	1.59	4.21	3.35	1.76	3.67	1.94	1.90	1.25	1.32	1.63	2.21
41.34	45.86	34.61	44.37	26.77	29.13	30.86	34.95	32.74	26.54	36.56	35.59

COMMENTS AND DEDUCTIONS.

ANY discussion of the sanitary condition of Chicago must take into account the character of its population in connection with its mortality statistics. The general health in relation to preventable diseases may index the sanitary care exercised by the authorities and by the citizens; but the healthfulness of the site will be most directly indicated by those born to the soil.

Not over one-third of the present population is autochthonous, or born on the soil, and one-half has actually come to the city since 1880 or within twelve years. The incoming population is in large proportion of a virile type and of an age when the death rate is at a minimum. The proportion of old people is small and the proportion of children is rapidly increasing as is to be expected from the character and age of the adult population. This of itself promises a large increase of population in the next decade, even though the influx of adults should fall off. If the conditions were every way favorable—a healthful site, needful public works and proper sanitary care—the death rate should be phenomenally low, much lower than it is and very much lower in comparison with older cities. The large ratio of deaths from preventable diseases and especially the death-rate among children, who may be assumed as native to the situation, are not reassuring.

Although the death rate as a whole is not high as compared to many other cities, there is no comfort in this fact after the attending circumstances are considered.

The site of Chicago is the bed of an old bay of Lake Michigan, when the lake stood some thirty feet higher and discharged from the head of the bay, near Summit, down the valley of the Des Plaines and Illinois rivers. The bay was in crescent shape, swinging from Rose Hill on the north southwesterly through Jefferson and Cicero to Riverside, thence sweeping around to the head of the Blue Island ridge and toward the Calumet on the

south. The shore was marked by a beach of sand and gravel, which extends northerly as the west ridge at Evanston and southerly behind Pullman and, with some breaks, sweeps easterly into Indiana. The horns of this crescent are eighteen miles apart and the depth is eight miles. To the north and west the ground rises in a series of clay ridges, between which the streams trend southward, as the North Branch, the Des Plaines and Salt Creek; while to the south are heights of clay which separate the Chicago basin from "the Sag." Generally the outlying clays are unmodified drift, not covered to any considerable depth with soil.

The bed of the old bay, however, is a plain composed of a softer and less homogeneous clay, and much of its area was less than ten feet above the present lake level, while that bordering the Chicago river and branches was practically at high water, and generally was covered with a considerable depth of mucky soil. In front of the crescent is a shore strip from one to three miles wide, the clay lying at the lake level or below and covered with sandy and peaty soil, old sand-pits and wind-blown ridges from the modern lake. Extending from the shore inland opposite the middle of the crescent and about the river and branches is the site of the actual city. Some ninety per cent. of the population is on an area of 64 square miles, included within a radius of six miles.

The street grade of the city is established at 14 feet above the low lake level of 1847, and a large proportion of the central and most populous area has been raised to this level. The process is still going on and up to a recent date, almost anything was deemed suitable for filling. To the west and south of Jackson Park are many miles of low ground, scarcely above high lake, occasionally flooded from land water, many feet in depth of porous soil, which it is proposed to render more habitable by pumping the ground water down below the lake level.

It will be perceived, therefore, that much of this densely inhabited area is over a porous stratum of mucky soil, fine sand and miscellaneous filling, varying in depth from five to twenty feet. The growth to the northwest, west and southwest is over territory more favorable, while to the south the conditions are much worse. Near the shore to the north, in Lake View, the porous stratum is of considerable depth.

To the extent that this area is of considerable depth and the surface unprotected, the conditions are favorable to soil saturation by communal filth, with all the sanitary ills attendant thereon. These conditions are characteristic of a large proportion of the populous area. The sewers are necessarily of low grade over the central area and deposits occur in the mains, cleansed only by storm flushing or occasionally by the city sewer department.

The river system—originally stagnant bayous flushed only by rain or melting snow—has been developed into a harbor, consisting of the main channel and slips, which, with a length of over twenty-four miles meander through the populous area. This harbor is the cess-pool for nearly all the sewage of the city, and is without circulation, except by artificial means or when flood waters sweep its contents lakeward.

The contribution to the sewers from the public water supply is 12,000 to 15,000 feet per minute and to the North Branch from the conduit about the same, or an aggregate of 25,000 to 30,000 cubic feet per minute, so that the canal pumping station must be kept in efficient operation to even take care of what comes to the river in dry weather when there is no land water, and to prevent the contents from reaching the lake in its frequent and irregular oscillations. It is apparent that the sewage is so large a proportion of the volume pumped at Bridgeport that the dilution is without significance, and that the circulation largely substitutes new sewage rather than a supply of lake water. It is also apparent that the pumps may fail even to remove the volume contributed by the water supply and the Fullerton conduit, and at their best they are insufficient to cope with any considerable additional volume from rain or melting snow.

The following memorandum in regard to the volume pumped from January 1, 1887, to September 30, 1892, is furnished by the Engineering Department of the Sanitary District. Since October, 1892, the volume has been much less—the monthly readings showing an average of not more than 26,000 cubic feet per minute.

Volume Pumped into Canal at Bridgeport.

Year.	Month.	Feet per minute.
1887.	January 1-31	48,000 to 58,000
	February 1 to March 20—no pumping except six days in February and five days in March	35,000 to 40,000
	March 21 to July 9, average	46,000
	July 10 to October 10	46,000 to 52,000
	October 10 to December 31	38,000 to 43,000
1888.	January	38,000 to 43,900
	February 1 to 25	31,000 to 36,000
	February 26 to March 23	40,000 to 50,000
	March 24 to April 30	30,000 to 36,000
	May 1 to June 14, average	40,000
	June 15 to September 30, average	47,000
	October and November	37,000 to 40,000
	December	31,000 to 36,000
	Except three days in March, seven days in May and four days in May and June, when the canal carried by gravity, from	18,000 to 22,000
1889.	January, February, March, April and May	34,000 to 37,000
	June	25,000 to 32,000
	July 1 to 19, average	40,000
	July 20 to 31	44,000 to 50,000
	August, September and October	42,000 to 46,000
	November and December	33,000 to 36,000
	Except one week in July and August, with no pumping.	
1890.	January 1 to February 25; no pumping. Canal carrying by gravity	12,000 to 16,000
	February 26 to March 11	30,000 to 44,000
	March 12 to December 8	45,000 to 53,000
	December 9 to 16	43,000 to 45,000
	December 17 to 31	36,000 to 40,000
1891.	January, February, March and Apri	25,000 to 35,000
	Except one week in January and two in April of 40,000 and upward, due in part to floods—	
	May, June, July, August	40,000 to 50,000
	September, average	36,000
	October, average	39,000
	November and December, average	33,000 to 34,000
	Except no pumping for one week in July	25,000
1892.	January, February, March	32,000 to 37,000
	April	25,000 to 30,000
	Except one week above 40,000.	
	May and June	40,000 to 43,000
	Except for flood interruptions.	
	July, August and September, general average	45,000

Of the total population of 1,438,000 it is estimated that 1,194,500 sewer directly to the river system, 185,500 directly to the lake along the city front and 58,000 are outside the sewerage area. Many industries characteristic of Chicago are enormous producers of organic waste, as stock-yards, rendering houses, distilleries, breweries, glucose works, etc. From chemical analysis and other data, it is inferred that the total sewage product is equivalent to an ordinary city of three million people, judging by Eastern and foreign standards. Nearly all these special industries are adjacent to the river system, so that the proportion of filth tributary thereto is larger than is indicated by the above figures as to population.

The North Branch, between Fullerton avenue and its junction with the main river, some 4.8 miles, including the Ogden canal, receives the sewage of a population of about 345,500 and that of many special industries. Circulation is produced by means of the Fullerton ave. conduit through which is introduced from 14,000 to 16,000 cubic feet per minuue of lake water, thus changing its contents in about eighty hours and sending the same to the junction with the main river, there to join the flow drawn through the main river and South Branch to the canal by the pumping station at Bridgeport.

The main river and South Branch extend from the Lake to Bridgeport, 5.3 miles with 4.2 miles of adjacent slips, and the population directly tributary is about 577,500 with fewer special industries than on the North Branch.

The nominal capacity of the canal pumping station is 60,000 cubic feet per minute. In the last five years it has exceeded 50,000 feet for a few months only, and has generally ranged from 35,000 to 45,000 feet, though for several months of the past year, the volume did not exceed 30,000 to 35,000 feet per minute. There have been several interruptions for repairs and changes of weeks and months duration, with the canal only taking a gravity flow, which in the last three years of extraordinary low lake has not exceeded 10,000 to 15,000 cubic feet per minute. If the station was operated continuously at its normal capacity, it would change the contents of the main river and South Branch every 24 hours.

There are tributary to the North Branch above Fullerton ave., and to the west and south forks of the South Branch a population of about 271,500 with an enormous development of special industries adjacent to the South fork. The areas, aggregating some 9.5 miles of channel and slip excavated for harbor purpores, are without circulation.

The large sewage product which reaches the uncirculated areas in dry weather is practically spent in those parts of the river system. This is fully evidenced by the phenomenal ebullition of gases and the enormous deposits of sludge, more largely from the decomposing solution than by direct sedimentation of solids. In the areas circulated the sewage is much spent in warm weather and the ebullition of gases and deposits of sludge are only less characteristic. Indeed, this must be apparent, considering the known rapidity with which certain constituents of sewage break up with a favoring temperature. The chemical analyses made at Bridgeport by the STATE BOARD OF HEALTH are confirmatory of the advanced stage of decomposition and would seem to indicate that, in some seasons of the year, the undecomposed organic product going into the canal is but 25 to 30 per cent of the total sewage production of the city, the remainder being dissipated as gases or thrown down as sludge and going lakeward. A thorough examination of the river system does not render this estimate improbable.

In flood time all sewage goes to the lake and periodical freshets also remove the sludge accumulations, except from the quietest areas. It is a significant fact that one of the large sewers of Chicago, serving a district but partly paved, shows a higher proportion of organic matter when flushed by heavy rain than in the dry-weather flow. What the result would be with a storm continuing for two or three days, or with extraordinary precipitation, or on a different type of district, data have not been obtained to show. But when the city is taking a rain-bath—washing down roofs, cleansing streets, flushing catch basins and sewers and leaching out all the noisome accumulations of filth while drenching areas and back lots—it must be concluded that flood waters from the urban areas are highly charged. The condition in flood time is not so patent owing to less time for offensive decomposition, but even in the recent extraordinary

June, 1892, freshet, when 700,000 cubic feet per minute was going out of the Chicago river, the presence of sewage was sufficiently evident to eye and nose.

No more than an assumption can be made as to the ultimate destination of Chicago sewage, but considering all the conditions and circumstances throughout the year, (and the data are far from conclusive) it may be inferred that the equivalent of one-third of the total amount of undecomposed sewage product goes out by the canal, one-third finds its way to the lake and the other third is dissipated as gases of decomposition throughout the atmosphere of the city. Any change in these figures is likely to decrease the proportion lakeward and increase that spent in polluting the city atmosphere.

The public water supply of Chicago is taken from Lake Michigan and the records of the STATE BOARD OF HEALTH show that, except for some hardness, it is normally an unobjectionable water. It is, therefore, only as it is affected by pollution that it may be considered as an agency conducive to zymotic disease.

Referring to Map No. 8 the main arteries of the water supply are shown: The Lake View intake at the north opposite, the 25th ward; the shore inlet, opposite the 24th ward; the two-mile tunnel, also opposite the 24th ward; the Hyde Park tunnel opposite the 33rd ward and near Jackson Park; the four-mile tunnel opposite the 1st ward.

The water obtained at the Lake View intake supplies in general the region north of Fullerton or Lincoln Park, as indicated by the size and arrangement of the water pipes. Until during the summer of 1892, the water was taken from the lake at a point about 2,000 feet from the shore line, and was admitted through iron pipes on the bottom of the lake. Since that time it has been admitted to a tunnel at a point about one mile from the shore. This tunnel is now being extended and when completed the supply will be taken from a point two miles from shore. The 2,000 ft. point is the only one pertinent here, except for the latter part of 1892.

The shore inlet has at times been considered a questionable source of water supply. It has been in general use during the whole period covered by this investigation, being out of service but a short time. During 1890 and 1891 the water was taken

from a point about 1,500 feet from shore during 1892 from a point on the break-water about three-quarters of a mile from shore. Both points of intake are about one mile north of the mouth of the Chicago river. The percentage of the total supply taken from this inlet is not known. The region supplied with the water taken from this inlet is, of course, a matter of great interest. It cannot be discussed separately from the supply by the two-mile tunnel, but will be considered in connection with the discussion of the distribution of the water supply.

The two-mile tunnel takes water from a point on the lake two miles from shore and from the mouth of the Chicago river, known generally as the "two-mile crib." At this point two water-supply tunnels originate, one five (5) feet and the other seven (7) feet in internal diameter. Both reach the shore at Chicago avenue close to the termination of the Shore Inlet. The 5-ft. tunnel terminates here, but the 7-ft. tunnel continues across the city, as shown on the map, and terminates at the pumping station at Ashland avenue and Twenty-second street. On its course it is tapped by the pumping station at Des Plaines and Harrison streets. In general, the water from the two-mile tunnel, combined with the shore inlet water, supplies all of the region between Fullerton avenue on the north and Thirty-ninth street on the south, as indicated by the size and arrangement of water-pipes.

The Hyde Park tunnel water supply is obtained from a point about 6,000 feet from shore and about three miles from the mouth of the Calumet river. The region generally supplied therefrom is that part of the city south of Thirty-ninth street.

The four-mile tunnel is not discussed in this connection, since it was not a factor during the period under consideration.

The water supply has been distributed from five places:

1. Lake View pumping station, supplying the region north of Fullerton avenue. Particular attention is called to this fact in connection with the distribution of death rate in this region, account being taken of the fact that the water was drawn from a point only 2,000 feet from the shore most of the time. The death rate from typhoid fever is especially high in the region thus supplied.

2. North Side pumping station, located at Chicago avenue on the lake shore, and supplying the region in which it is central, and south of Fullerton avenue. Diagram No. 1 shows on an enlarged scale the arrangement of water intakes and distributing pipes at this station. It shows that the Shore inlet connects quite directly with the pumping engines on Pearson street. It is quite apparent also that the 7-ft. tunnel to the two-mile crib connects directly with the West side pumping station. It shows, too, that both these sources of supply connect indirectly with the engines facing Tower place, and that the 5-ft. tunnel to the two-mile crib connects directly therewith. It is evident, further, that the Shore inlet water must be mainly distributed from this pumping station, diluted somewhat by water from the 5-ft. tunnel. Further, it is hardly possible that any of the Shore inlet water goes toward the West side. It must be concluded, then, that this pumping station distributed the Shore inlet water. It remains to fix the boundaries of the region this supplied.

In the winter of 1886-87, Engineer Thomas T. Johnston, to whom the Secretary is indebted for the information here given, directed a pressure survey of the water-supply system of the city between Fullerton avenue and 39th street. The results of this survey demonstrated that this pumping station at that time supplied the region south of Fullerton avenue and east of the North branch of the Chicago river; also to some extent the business district just south of the main river, but none of the region west of the North branch. Six months later the pumps facing Pearson street, adding from 20 to 30 per cent. to the water supply, were put in action.* The additional water supply thus pumped went mainly through pipes leading directly to this region just west of the North branch. It follows then that the region supplied from this station embraced the area east of the river covered by the 20th, 21st, 22nd, 23d and 24th wards, and in addition all or large parts of the 14th, 15th, 16th and 17th wards. No changes or additions have been made to the pumping plants of the city that could materially affect this distribution of the supply.

* Mr. Johnston was at that time and subsequently connected with this pumping station and thus had the fullest opportunity for observation.

The area thus defined and supplied is that in which there has been an excess of deaths due to typhoid fever.

3. Des Plaines street pumping station—located as shown on the map, and which had only one pump in operation, supplying a region central to itself, but of no great area. The exact area is immaterial, for the same water is supplied from the pumping station next to be described, and the combined area supplied can be quite definitely defined.

4. West Side pumping station—located at Ashland avenue and Twenty-second street. In conjunction with the Des Plaines street pumping station, it has distributed all the water coming through the 7-foot tunnel from the two-mile crib, shown on Diagram No. 1. All this water is, nearly to a certainty, derived from the two-mile tunnel, and this water supplies all the region between Thirty-ninth and Fullerton avenue, except the region supplied from the North Side pumping station. It is possible, too, that some small quantity of this water has gone south of Thirty-ninth street.

5. Hyde Park pumping station—located on the lake shore just below Jackson Park. The source of supply is evident on the map, likewise the area supplied, which is south of Thirty-ninth street. As already stated, it may be that an immaterial quantity of water crosses Thirty-ninth street towards the south.

It is a patent fact that the water supply of Chicago is at times badly polluted and is at all times regarded with suspicion. The general nature of the pollution is well understood and is sufficiently indicated in the preceding descriptions of the sewage and sewerage of the city, and of the sources and distribution of the water supply.

But there are other factors than an impure water supply in the abnormally high death rate of Chicago. To air pollution due to noxious emanations from decomposing stagnant sewage there must be added both air and soil pollution from the enormous industrial filth producers, acting irresponsibly and without proper police control; from stables for cattle and horses not properly constructed, nor sewered nor cared for; from garbage, offal and refuse accumulated in alleys and upon premises—too frequently in the poorer wards; from surface privies without adequate sewer conections; from lots and areas below the street

level, with houses built over filthy pools or on ground saturated after every rainfall; from uncleaned, unpaved, unditched streets and alleys; from improper street and lot filling; from unsewered and more or less densely-populated areas and from many similar sources.

Some of these conditions are within the control of the private citizen and individual householder, but all are directly within the scope and purview of the municipal authorities whose paramount duty is the protection of the public health. These should exercise fully the police power in control of the great filth produers and in securing rigid sanitary conditions about premises and establishments, including efficient plumbing and sewer connections.

They should clean the city and keep it clean and stop the perpetual tearing up of streets and excavations for buildings in the hot season.

They should operate the Bridgeport pumping station to its full capacity and increase and maintain the same at the full capacity of the canal, or not less than 80,000 cubic feet per minute, so as to circulate the river more freely and to keep its contents from the lake.

They should extend the pavements and adopt more generally a style of construction such as will shed water quickly and prevent saturation of the permeable filling beneath; remove porous material from areas subject to filth saturation; fill lots to grade with suitable material and stop burying mucky soil underneath; make the ditches efficient in the sparsely settled or unsewered districts and drain out all bogs and ponds.

They should push tunnel extensions so as to bring a purer off-shore water supply into active service and copious use.

They should adopt some means for circulating the South fork, however primitive and inefficient it may prove.

Finally they may take the Sanitary Exhibit of the ILLINOIS STATE BOARD OF HEALTH as an index of the conditions which cry out for remedy—as a graphic presentation of the chief causes of undue loss of life and coincident impairment of the working force and value of the population of the World's Fair city.